

NOTES ON THE TAXONOMY OF NOCTUID LARVÆ
(Lepidoptera)

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The difficulties involved in the taxonomy of lepidopterous larvæ are well known. The work of Forbes, Dyar, Smith and others has led to the useful identification of the supra-generic categories in the order and has clarified many phylogenetic relations that could not have been understood from a study of the adults alone. But so similar are the great number of caterpillars that in only a few families have adequate generic and specific characters been found. In one of the largest and most economically important families, the Noctuidæ, the taxonomy of the larvæ has proceeded so slowly that relatively few of the 4000 or more species of North American noctuid larvæ can be positively identified. One may often compare the larvæ of two distinct species, segment by segment and part by part, without finding an applicable diagnostic character.

The purpose of this paper is to briefly illustrate some structural variations which are of taxonomic value in the study of noctuid larvæ by use of two closely related species in the genus *Heliothis*. The writer has recently been engaged in extending the work of Lange and Michelbacher (1) in the separation of *Heliothis obsoleta* (Fabr.) from *H. phloxiphaga* G. and R. in the larval, pupal and adult stages. The moths often occur together in the tomato fields of central California, although only the corn earworm can pass its life cycle on tomato. In these areas *H. phloxiphaga* larvæ feed chiefly on *Hemizonia congesta* (tarweed) and *Grindelia robusta*. The adults are easily separated, the pupæ less so, but the larvæ are sometimes almost indistinguishable.

Color and size are the most obvious characters, but they must be employed with caution. The color pattern of some noctuid larvæ varies greatly, depending on the stage of larval development, the host plant or plant part attacked and perhaps the temperature and season. The size attained by full grown caterpillars may depend on the nature and abundance of food.

H. obsoleta ranges in color from green, pink or brown to slate gray with white bands. It has been observed in this lab-

oratory that on corn the larvæ tend to be yellow and pale brown, on alfalfa dark green, on lettuce pale brown and on tomatoes brown with red and green hues. *H. phloxiphaga* varies from slate gray with prominent white stripes on tarweed to dark green on *Grindelia*. In the laboratory these caterpillars may be successfully reared on lettuce and tend to be dark green in color. Other noctuid larvæ, such as *Autographa californica* (Speyer), show less range in color pattern.

Sixth instar larvæ of *obsoleta* are larger than those of *phloxiphaga* in the corresponding stage. In young larvæ, however, there is no difference in size. The stage of larval development and the environmental conditions should be taken into consideration in using color and size as specific characters.

The pigment pattern of the cuticle is not destroyed by ordinary reagents. It is composed of a more or less definite arrangement of small oval or round areas. In *phloxiphaga* these maculations are more numerous in the dark sub-dorsal bands than they are in the same areas of the corn earworm. In early stages these differences do not obtain. The microscopic structure of the cuticle offers generic characters. In *Heliothis* the skin is thickly beset with minute, sharply conical spinules. It is quite likely that in some genera the structure of the cuticle may be of specific value.

The size of the primary setæ and setigerous tubercles is of value. Typically, *phloxiphaga* is spinose with dark sub-conical tubercles, while *obsoleta* is rather smooth and has smaller, paler tubercles. But those factors influencing color may often cause changes in the appearance of the setæ. Dark larvæ tend to appear more spinose than pale individuals.

The arrangement of the primary setæ of noctuid larvæ is so uniform that they offer no satisfactory taxonomic characters. The form and number of the crochets on the abdominal legs and the shape or size of the spiracles are as yet of minor systematic importance. In the two species of *Heliothis* referred to, the shape and size of the tarsal claws are similar, but this structure can often be used for the separation of genera in the family. The shape and size of a sclerotized area is of fundamental importance in a study of this kind and no such region should be neglected.

It is probably in the larval head that the most valuable diagnostic characters can be located. It will be desirable first to

enumerate a few structures which are similar in *obsoleta* and *phloxiphaga*, but have been used to separate other noctuid species. (1) the arrangement of ocelli, (2) the size and shape of the adfrontals and clypeus, (3) the length of the epicranial stem (the dorso-median suture of the head), (4) the mandibular dentes and basal processes, (5) the shape and relative size of the sclerotized areas of the antennæ and labium and (7) the palpi and their setæ.

The cuticular coloration of the head frequently offers specific characters. In many species the vertex is darker than the rest of the head. *H. phloxiphaga* may conveniently be distinguished from the corn earworm by the reticulate, fuscous, sub-median arcs of the head.

The internal, or posterior, face of the labrum presents several characters of value—the epicranial setæ, the epicranial shield (the thickened area on the ventral margin) and the labral notch. In *obsoleta* the epicranial shield is somewhat larger and the notch relatively shallower than in *phloxiphaga*. The epicranial setæ are similar in the two species, although slightly larger in full grown corn earworms.

Ripley (2) has shown that the labro-hypopharyngeal complex which forms the spinneret and its supporting structures in lepidopterous larvæ is of great value in taxonomic work, although the homologies of this area are not clearly understood. The spinneret is located on the mesal portion of the membrane between the palpigers. The proximal sclerite of the spinneret varies in shape and secondary chitinization within the family. In the Noctuidæ the palpigers form an incomplete ring, ending dorsally at the labial palpi. The sensorium on either side of the median ventral line is partially surrounded by a chitinized extension of the palpiger, differing in shape within the family. In *Heliothis* the hypopharynx is covered with numerous, short, stout setæ which are longer at the lateral margins.

The two species of *Heliothis* studied are so closely related that, of the above characters, only the palpigers are of specific value and even then, just in mature larvæ. In *obsoleta* the palpigers are narrower and the dorso-cephalic angle is more produced than in *phloxiphaga*. In addition, the proximal sclerite of the labial palpi is usually larger in the former species.

The taxonomic value of the spinneret and its allied structures

has perhaps not yet been realized. These structures are of particular significance in those cases in which the more obvious characters are not conclusive. A systematic arrangement of noctuid larvæ can only result from a more detailed morphological examination of all larval structures. Such progress should be of special importance to lepidopterists and agricultural entomologists.

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REFERENCES

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NOTES ON NORTH AMERICAN SPECIES OF MEGARHYSSA

(Hymenoptera, Ichneumonidæ)

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The genus *Megarhyssa* Ashmead has recently been placed by Roman (1933:38) in synonymy with *Pimpla* Fabricius on the basis of a supposed type designation by Fabricius. However, as pointed out by Richards (1937:117), Fabricius did not designate genotypes in the sense of the present code of nomenclature; he merely described one species in most of his genera more fully than any of the others. For this reason, it seems that *Megarhyssa* should not be considered a synonym of *Pimpla*.

Although several authors have given keys to our four species of *Megarhyssa*, identification of certain specimens has remained difficult because of the great color variation in some species. In the keys here given, therefore, an attempt has been made to use structural characteristics in separating the species.

KEY TO THE NORTH AMERICAN SPECIES OF MEGARHYSSA

FEMALES

1. Middle of posterior margin of heavily sclerotized portion of first sternite distinctly behind a vertical line through posterior end of first abdominal spiracle; ovipositor about one and one-half times as long as body; length of sclerotized part of